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| 10/555,179 | 10/31/2005 | Peng Wang | ECPO-3 | 2643 |
| 53450 7590 03/01/2011 KRIEG DEVAULT LLP ONE INDIANA SQUARE SUITE 2800 INDIANAPOLIS, IN 46204-2079 | | | EXAMINER DAM, DUSTIN Q | |
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/555,179

Applicant(s)

WANG ET AL.

Examiner

DUSTIN Q. DAM

Art Unit

1728

Period for Reply -- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 07 December 2010.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-3,5-9 and 11-29 is/are pending in the application.
- 4a) Of the above claim(s) 5,7,8 and 16-20 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-3,6,9,11-15 and 21-29 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-946)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

Summary

1. This Office Action is in response to the Amendments to the Claims and Remarks filed December 7, 2010.
2. In view of the Amendments to the Claims filed December 7, 2010, the rejections of claims 1-4, 9-15, and 21-29 under 35 U.S.C. 112, second paragraph, and 35 U.S.C. 102(a, b, & e) and 103(a) previously presented in the Office Action sent August 2, 2010 have been withdrawn.
3. Claims 1-3, 5-9, and 11-29 are currently pending while claims 5, 7, 8, and 16-20 have been withdrawn from consideration. Claims 1-3, 6, 9, 11-15, and 21-29 have been fully considered.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

5. Claim 12 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

- a. Claim 6 requires the compacting compound of claim 1 to be cyclohexane-carboxylic acid, adamantane acetic acid, adamantane propionic acid, or 4-pentylbicyclo(2,2,2)-octane-1- type carboxylic acid. The specification does not appear to sufficiently evidence applicant had in possession, at the time of the filing, an invention wherein the compacting compounds of claim 6 are within formula 1 or 2 of claim 1.
6. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.
7. Claim 6 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.
 - a. Claim 6 requires the compacting compound of claim 1 to be cyclohexane-carboxylic acid, adamantane acetic acid, adamantane propionic acid, or 4-pentylbicyclo(2,2,2)-octane-1- type carboxylic acid. It is unclear as to how a compacting compound can have the formula (1) or (2) of claim 1 and also be one of the compacting compounds of claim 6.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

10. Claims 1-3, 6, 9, 11, and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over SPITLER et al. (U.S. Patent 6,359,211 B1).

a. With regards to claim 1, SPITLER et al. discloses a regenerative photoelectrochemical cell comprising a photoanode (see line 11-20, column 8 disclosing “dye-sensitized nanocrystalline TiO₂ layers that have been coated on transparent conducting SnO₂ glass” which is interpreted to read on the claimed “photoanode”), said photoanode comprising at least one semi-conductive metal oxide layer (the “TiO₂” layer described on line 11-20, column 8) on a conductive substrate (the “transparent conducting SnO₂ glass” described on line 11-20, column 8), sensitized by a photosensitizing dye (see line 11-20, column 8 teaching “dye-sensitized”), a counter electrode (see line 11-20, column 8 “counterelectrode in the form of transparent conductive SnO₂”) and an electrolyte arranged between said semi-conductive metal oxide layer and said counter electrode (see line 11-20, column 8 “regenerating agent electrolyte”), and an amphiphilic compacting compound whose molecular structure inherently comprises at least one anchoring group, a hydrophobic portion, and a terminal group, said compacting compound being co-absorbed with said photosensitizing dye on

said semi-conductive metal oxide layer in a mixed monolayer, and is a compound having the formula (1) of claim 1 (line 28-38, column 7 discloses using more than one dye in a mixed monolayer attached to the metal oxide; in this embodiment, the first dye is interpreted to read on the claimed "compacting compound" while the more than one dye is interpreted to read on the claimed "photosensitizing dye"; see claim 11 which discloses the functional attachment group of the cited compacting compound may be an "alkyl linking chain" which is terminated in a "phosphonic acid group" which is interpreted to provide for the alkyl phosphonic acid type formula (1) of claim 1 all but the explicit disclosure of n being integers from 1-20). However, SPITLER et al. teaches, in every example, alkyl chains with n being an integer between 1 and 20 (see column 5-7). Thus, at the time of the invention, it would have been obvious to a person having ordinary skill in the art to have selected n to be an integer from 1-20 in the multi-dye embodiment because SPITLER et al. explicitly suggest using n as an integer between 1 and 20 for the alkyl chains.

b. With regards to claims 2 and 3, independent claim 1 is obvious over SPITLER et al. under 35 U.S.C. 103(a) as discussed above. SPITLER et al. discloses a conventional dye-sensitized solar cell comprising the structure of a self-assembled dense packed mixed monolayer of multiple dyes (line 28-38, column 7).

While SPITLER does not appear to explicitly disclose the ratio of the first dye, cited compacting compound, to the "more than one dye" or the order-disorder transition temperature of the mixed monolayer, SPITLER recognizes the relative amounts and types

of dyes used is to extend the spectral range of sensitivity of the solar cell (see line 38-43, column 8).

Thus, at the time of the invention, it would have been obvious to a person having ordinary skill in the art to have optimized the ratio of the first dye, cited compacting compound, and the more than one photosensitizing dye and arrive at the claimed range for compacting compound to photosensitizing dye and order-disorder transition temperature of the mixed layer through routine experimentation (see MPEP 2144.05); especially since it would lead to optimizing the spectral range of sensitivity.

c. With regards to claims 6 and 11, independent claim 1 is obvious over SPITLER et al. under 35 U.S.C. 103(a) as discussed above. SPITLER et al. discloses a conventional dye-sensitized solar cell comprising a compacting compound which is an alkyl phosphonic acid (see claim 11 as described above), the alkyl chain being the terminal group with a hydrophobic chain and the phosphonic acid being the anchoring group.

d. With regards to claim 9, independent claim 1 is obvious over SPITLER et al. under 35 U.S.C. 103(a) as discussed above. SPITLER et al. discloses a conventional dye-sensitized solar cell comprising a compacting compound having an alkyl chain (see claim 11 as discussed above and see examples in columns 5-7).

SPITLER et al. does not appear to explicitly disclose the length of the alkyl chain is such that it allows the terminal group, the alkyl, to protrude above the **photosensitizing** dye in the monolayer.

However, the length of alkyl chains directly affects the polarity of the molecule, meaning it directly affects the hydrophobic nature of the molecule. Thus, at the time of

the invention, it would have been obvious to a person having ordinary skill in the art to have optimized the length of the alkyl chain in the device of SPITLER et al. and arrive at the claimed range for alkyl chain length through routine experimentation (see MPEP 2144.05); especially since it is well recognized that chain length affects polarity.

e. With regards to claim 21, independent claim 1 is obvious over SPITLER et al. under 35 U.S.C. 103(a) as discussed above. SPITLER et al. discloses a conventional dye-sensitized solar cell characterized in that said electrolyte comprises a redox system and said redox system comprises an electrochemically active salt and a first compound forming a redox couple with either the anion or the cation of said electrochemically active salt (see line 11-20, column 8 "0.5 M I⁻ and 0.030 M I₂").

11. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over SPITLER et al. (U.S. Patent 6,359,211 B1), as applied to claims 1-3, 6, 9, 11, and 21, and in further view of IKEDA et al. (WO 02/011213 as a 102(b) date with citations from English equivalent U.S. PG-Pub 2003/0152827 A1).

a. Independent claim 1 is obvious over SPITLER et al. under 35 U.S.C. 103(a) as discussed above. SPITLER et al. discloses a conventional dye-sensitized solar cell comprising a first dye, cited compacting compound, and more than one dye.

SPITLER et al. does not appear to explicitly disclose a compacting compound such as cyclohexane-carboxylic acid.

However, IKEDA et al. discloses a dye for a dye-sensitized solar cell and discloses the dye may comprise carboxylic acid (see formula (1) in paragraph [0021] with the "HOOC" group) and cyclohexane (see paragraph [0025] and [0040] disclosing each

A1 and A2 of formula (1) may be hydrogen or “cyclohexane”) which is interpreted to read on the claimed cyclohexane-carboxylic acid.

Thus, at the time of the invention, it would have been obvious to a person having ordinary skill in the art to have substituted the first dye of SPITLER et al. for the dye of IKEDA et al. which includes the cyclohexane-carboxylic acid because the simple substitution of a known element known in the art to perform the same function, in the instant case a photosensitizing dye for a photosensitizing solar cell, is a matter of obviousness (see MPEP 2141{III}{B}).

12. Claims 13-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over SPITLER et al. (U.S. Patent 6,359,211 B1), as applied to claims 1-3, 6, 9, 11, and 21, and in further view of SIGMA-ALDRICH (MSDS for “cis-Bis(isothiocyanato)(2,2'-bipyridyl-4,4'-dicarboxylato)(4,4'-di-nonyl-2'-bipyridyl)ruthenium(II) 4/7/2009).

a. With regards to claims 13-15, independent claim 1 is obvious over SPITLER et al. under 35 U.S.C. 103(a) as discussed above. SPITLER et al. discloses a photochemical cell comprising a photosensitizing dye (the “more than one dye” described in line 28-38, column 7).

SPITLER et al. does not appear to explicitly disclose a cell characterized in that said photosensitizer dye is cis-Bis(isothiocyanato)(2,2'-bipyridyl-4,4'-dicarboxylato)(4,4'-di-nonyl-2'-bipyridyl)ruthenium(II).

However, SIGMA ALDRICH's MSDS discloses cis-Bis(isothiocyanato)(2,2'-bipyridyl-4,4'-dicarboxylato)(4,4'-di-nonyl-2'-bipyridyl)ruthenium(II) as a sensitizing dye.

Thus, at the time of the invention, it would have been obvious to a person having ordinary skill in the art to have substituted the cis-Bis(isothiocyanato)(2,2'-bipyridyl-4,4'-dicarboxylato)(4,4'-di-nonyl-2'-bipyridyl)ruthenium(II) complex sold by SIGMA ALDRICH for the photosensitizer dye in the cell of SPITLER et al. because the simple substitution of a known element known in the art, in the instant case a dye for a dye sensitized solar cell, is a matter of obviousness (see MPEP 2141{III}{B}).

13. Claims 21-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over SPITLER et al. (U.S. Patent 6,359,211 B1), as applied to claims 1-3, 6, 9, 11, and 21, and in further view of CHITTIBABU et al. (U.S. PG-Pub 2004/0025934 A1).

a. With regards to claims 21-27, independent claim 1 is obvious over SPITLER et al. under 35 U.S.C. 103(a) as discussed above. SPITLER et al. discloses a photochemical cell comprising an electrolyte.

SPITLER et al. does not appear to explicitly disclose a photochemical cell wherein the electrolyte comprises the components claimed in claims 21-27.

However, CHITTIBABU et al. discloses a cell characterized in that said electrolyte comprises a redox system and said redox system comprises an electrochemically active salt and a first compound forming a redox couple with either the anion or the cation of said electrochemically active salt ([0053] "lithium iodide/iodine"). CHITTIBABU et al. discloses said electrolyte comprises a room temperature molten salt, said molten salt being a liquid at least between standard room temperature and 80°C above said room temperature ([0072] "Iodide based molten salts, e.g., methylpropylimidazolium iodide, methylbutylimidazolium iodide,

methhexylimidazolium iodide, etc.” which are interpreted to inherently be liquid at least between standard room temperature and 80°C above said room temperature).

CHITTIBABU et al. discloses said electrolyte further comprises a polar organic solvent having a boiling point of 100°C or greater than 100°C at normal atmospheric pressure ([0089] discloses addition of “t-butylpyridine based passivation agent” which [0088] discloses the agent may comprise “methoxypropionitrile”; the passivation agent is interpreted to read on the claimed organic solvent inherently comprising the claimed boiling point). CHITTIBABU et al. discloses said solvent is 3-methoxypropionitrile ([0089] discloses addition of “t-butylpyridine based passivation agent” which [0088] discloses the agent may comprise “methoxypropionitrile”; the passivation agent used specifically in EXAMPLE 14 disclosed in [0088-0089] which comprises “methoxypropionitrile” is interpreted to exist in a 3-methoxypropionitrile position). CHITTIBABU et al. discloses said electrolyte further comprises an additive of a neutral molecule characterized in that the molecule has the formula of claim 26 ([0089] discloses “methylbenzimidazole”). CHITTIBABU et al. discloses said electrolyte comprises an effective gelifying amount of gelifying compound ([0072-0073] describes “Gel Electrolytes” which is gelled by lithium metal ions and a complexing agent which “can be used to gel a suitable electrolyte solution” which is interpreted to be an “effective amount”).

Thus, at the time of the invention, it would have been obvious to a person having ordinary skill in the art to have substituted the electrolyte of SPITLER et al. for the electrolyte of CHITTIBABU et al. because the simple substitution of a known element

known in the art to perform the same function, in the instant case an electrolyte system in a dye sensitized solar cell, is a matter of obviousness (see MPEP 2141{III}{B}).

14. Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over SPITLER et al. (U.S. Patent 6,359,211 B1), as applied to claims 1-3, 6, 9, 11, and 21, and in further view of CHITTIBABU et al. (U.S. PG-Pub 2004/0025934 A1) and GREEN et al. (U.S. Patent 6,245,847 B1).

a. Independent claim 1 is obvious over SPITLER et al. under 35 U.S.C. 103(a) as discussed above. SPITLER et al. discloses a photochemical cell comprising an electrolyte.

SPITLER et al. does not appear to explicitly disclose a photochemical cell wherein the electrolyte comprises the components claimed in claim 22.

However, CHITTIBABU et al. discloses a cell characterized in that said electrolyte comprises a redox system and said redox system comprises an electrochemically active salt and a first compound forming a redox couple with either the anion or the cation of said electrochemically active salt ([0053] “lithium iodide/iodine”). CHITTIBABU et al. discloses said electrolyte comprises a room temperature molten salt, said molten salt being a liquid at least between standard room temperature and 80°C above said room temperature ([0072] “Iodide based molten salts, e.g., methylpropylimidazolium iodide, methylbutylimidazolium iodide, methlhexylimidazolium iodide, etc.” which are interpreted to inherently be liquid at least between standard room temperature and 80°C above said room temperature).

Thus, at the time of the invention, it would have been obvious to a person having ordinary skill in the art to have substituted the electrolyte of SPITLER et al. for the electrolyte of CHITTIBABU et al. because the simple substitution of a known element known in the art to perform the same function, in the instant case an electrolyte system in a dye sensitized solar cell, is a matter of obviousness (see MPEP 2141{III}{B}).

CHITTIBABU et al. does not appear to explicitly disclose the molten salt being a liquid at least between standard room temperature and 80°C above said room temperature.

However, GREEN et al. discloses molten salts in electrolytes which GREEN et al. discloses the molten salt to be liquid at a temperature range from room temperature to 80°C (line 36-38, column 1).

Thus, at the time of the invention, it would have been obvious to a person having ordinary skill in the art to have substituted the molten salt of CHITTIBABU et al. with the molten salt of GREEN et al., which is liquid between room temperature and 80°C, because the simple substitution of a known element known in the art to perform the same function, in the instant case a molten salt in an electrolyte system, is a matter of obviousness (See MPEP 2141{III}{B}).

15. Claims 27-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over SPITLER et al. (U.S. Patent 6,359,211 B1) in view of CHITTIBABU et al. (U.S. PG-Pub 2004/0025934 A1), as applied to claims 21-27 above, and in further view of MISRA et al. (U.S. PG-Pub 2004/0115524 A1).

a. With regards to claims 27-29, dependent claim 21 is obvious over SPITLER et al. and CHITTIBABU et al. under 35 U.S.C. 102(a) as discussed above. The combination of SPITLER et al. and CHITTIBABU et al. discloses a photochemical cell comprising a redox system electrolyte.

The combination of SPITLER et al. and CHITTIBABU et al. does not appear to explicitly disclose an electrolyte comprising the claimed gelifying compound in the claimed range between 2% and 50% by weight of the electrolyte.

However, MISRA et al. discloses an electrolyte and discloses a copolymer of PVdF-HFP may be added into an electrolyte to vary the viscosity of the electrolyte ([0042]). MISRA et al. also discloses an electrolyte comprising a redox system of salts and counter ions ([0040-0041]).

Thus, at the time of the invention, it would have been obvious to a person having ordinary skill in the art to have modified the electrolyte of the combination of SPITLER et al. and CHITTIBABU et al. to include the copolymer of PVdF-HFP, as disclosed by MISRA et al. because it would provide for controlling viscosity of the electrolyte. It would have also been obvious to a person having ordinary skill in the art to have substituted the electrolyte in the cell of the combination of SPITLER et al. and CHITTIBABU et al. with the electrolyte suggested by MISRA et al. because the simple substitution of a known element known in the art to perform the same function, in the instant case a redox system electrolyte in an electrochemical cell, is a matter of obviousness (See MPEP 2141 {III} {B}). It would have also been obvious at the time of the invention to a person having ordinary skill in the art to have optimized the amount of

the copolymer of PVdF-HFP in the electrolyte and arrived at the claimed range through routine experimentation (See MPEP 2144.05); especially since it would lead to optimizing the viscosity of the electrolyte.

Response to Arguments

16. Applicant's arguments with respect to claims 1-4, 6, 9-15, and 21-29 have been considered but are moot in view of the new ground(s) of rejection necessitated by applicant's Amendments to the Claims.

Conclusion

17. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a). Specifically, applicant has incorporated the limitations of original claim 10 into claim 1. The new combinations of limitations, such as the limitations of claim 12 which now additionally require the limitations of original claim 10, have not previously been presented to the Office.

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,

however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DUSTIN Q. DAM whose telephone number is (571)270-5120. The examiner can normally be reached on Monday through Thursday, 6:30 AM to 4:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jennifer Michener can be reached on (571)272-1424. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Jennifer K. Michener/
Supervisory Patent Examiner, Art Unit 1728

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February 23, 2011